until after the dissipation of the hurricane it is not improbable that the conditions induced by the latter were favorable for the formation of the tornado.

The typhoon that was in progress when the tornado described by Professor Barbour occurred was, according to the Rev. José Coronas, of the Philippine Weather Bureau, one of eight to visit the Far East in the month of August, 1923. It is known as the *Meiacosima and China Typhoon* and has been described by Father Coronas as follows:

The first part of the track of this typhoon is somewhat uncertain, although it probably formed on August 3 to 4 south of Guam near 145° longitude E. and 10° latitude N., moving northwestward until August 6 and then westward on the 7th and part of the 8th. The center can easily be situated in our weather map of the 8th, 6 a. m., near 130° longitude E., between 18° and 19° latitude N.; and at 6 a. m. of the 9th in about 127° longitude E., between 20° and 21° latitude N. The typhoon was moving then NNW. and so it struck the Meiacosima group of islands about 150 miles east of northern Formosa on the 10th. The station of Ishigakihima reported at 6 a. m. of that day a barometer as low as 722.5 mm. with hurricane winds from the N. From Meiacosima the typhoon inclined northwestward and entered China in the morning of the 11th between 27° and 28° latitude N. Once in China it moved again NNW., gradually recurving to the NE. on the 12th, and traversed Manchuria on the 13th.—EDITOR.

THE EYE OF THE STORM[1]

By DOUGLAS MANNING

[Alexandria Bay, N. Y.]

A rather interesting condition prevailed here yesterday morning, December 6, between 10 and 11:30 o'clock in the forenoon and, in my judgment, it was caused by the immediate passage of a vast low-pressure area centered over this vicinity, or in other words was the "eye of the storm."

At 7 o'clock in the morning when I stepped out of doors it was raining and the wind was blowing almost a whole gale out of the northeast, with the sky covered with dark masses of nimbuslike clouds moving out of the south-southwest and a low scud racing across it from the same direction as the wind or perhaps a point more from the east than the wind was. From then on the wind gradually diminished in force as a patch of blue sky that first appeared in the west approached and which appeared to occupy about a quarter of the sky, and from which the clouds seemed to melt and break away in all directions. As this clear area finally drifted overhead the wind died away completely making the surface of the St. Lawrence River, on the banks of which this village is situated, appear as a sheet of glass in sharp contrast to the white-capped waves kicked up by the northeast gale a short time before. At the same time the temperature which was standing around 36° F. rose to 44° F. and the sun came out making it feel like a day in Spring. Even the cirrus and heavy alto cumulus and stratus melted away in this area but all around us and especially to the west the sky was an angry black. I was sorry that I could not have observed my barometer at this time which read very low at 7 o'clock. This clear space soon passed over us followed by the wind suddenly coming out of the south and a heavy shower accompanied by a still further rise in temperature until the thermometer stood at 50°. After this the wind gradually got around to the southwest and began to blow around 30 to 35 miles per hour and with a drizzling rain and slowly falling temperature, with a tendency to blow in increasingly strong gusts. The cloud formation was that uniform grey seen at such times which is hard to classify otherwise than strato cumulus and nimbus which were moving from the southwest. This calm lasted about half an hour and to me was quite interesting.

[1] Mr. Manning's observations show the prevalence of a central core of calm in an intense extra-tropical cyclone that passed over his station as described. Reference to to the daily weather maps of the Weather Bureau show this cyclone to have had a small diameter and central pressure of 29.15 inches with a fully developed cyclonic circulation.—EDITOR.

551.573

NOTES, ABSTRACTS, AND REVIEWS

A METHOD OF COMPUTING EVAPORATION FROM TEMPERATURE GRADIENTS IN LAKES AND RESERVOIRS[1]

By GEO. E. McEWEN

[Author's abstract]

A satisfactory interpretation of observations on the distribution of temperature, salinity, and other properties of water in the ocean, lakes, or reservoirs demands the mathematical formulation and solution of certain ideal problems. Although "field" observations must underlie the development of appropriate ideal problems, methods similar to those of mathematical physics can be used in dealing logically with such data. Also, as far as practicable, use should be made of well-established principles of physics, based upon laboratory experiments, but the main purpose of it all is to coordinate observations of natural phenomena.

This paper presents certain results of attempting to coordinate the amount of radiant energy absorbed by fresh water, the heat removed by evaporation, the water temperatures at a series of depths, and the time rate of change of temperature at each depth. It does not present any explanation of the mechanism or cause of evaporation. The qualitative physical basis of the theory consists of the following fundamental assumptions:

1. Heat is supplied to the water at each level by the absorption of radiant energy according to the familiar exponential law. The rate at which heat energy is absorbed depends upon the amount penetrating the water surface, the distance below the surface, and the absorption coefficient.

2. At the surface thin volume elements are cooled by evaporation at a rate assumed to be uniform throughout the whole surface area under which the temperatures may be considered equal to those at the station where observations are made. But the actual reduction of temperature of any one element varies—that is, different elements are cooled for different lengths of time, and consequently have different temperatures and specific gravities before beginning their descent. Therefore, the greater the reduction of temperature, or the colder and heavier the elements are, the longer will be the time required to produce the change, and the less frequent will be their descent. Also the number of elements in a given area, having a given temperature reduction will be smaller the greater the amount of the reduction.

3. Each element descends to a depth at which the average (observed) specific gravity is slightly less than that of the descending particle—that is, equilibrium is approached but not completely attained. Consequently

[1] Original paper presented at meeting of American Meteorological Society at Lo Angeles. Calif.. Sept. 17-19, 1923.

all elements having specific gravities sufficiently greater than the mean at a given level descend through the horizontal plane at that level, and therefore displace lighter water upward through the plane at the same rate. Thus the magnitude of this upward flow of relatively warm and light water is greatest at the surface and decreases continually from the surface downward.

4. The velocity of descent of each element is proportional to the difference between its specific gravity and the average specific gravity of the water at that level.

5. The observed value of any property of the water, physical or chemical (temperature, salinity, CO, etc.), at any depth is the average of the values for all of the water particles or elements, both ascending and descending at that level.

From the assumptions stated above two fundamental equations, one a partial differential equation and the other an intrgral equation, have been deduced. The first involves the temperature of the rising elements and the second that of the rising elements, the descending elements, and the average, or observed temperature. In addition, the times, depths, and certain constants are involved. Although solution of the equations has not proved practicable, the variables entering in can be computed from temperature observations and the relation of specific gravity to temperature. Thus a series of equations, two for each depth, is formed in which the constants stand respectively for the rate of absorption of solar radiation by water, the rate of evaporation, and the rate at which solar radiation penetrates the water surface. The only observations required are the temperatures at a series of depths and their time rates of change at each depth.

Emphasis has commonly been placed upon meteorological observations rather than observations on the water itself in connection with evaporation researches. The importance of meteorological factors in evaporation is undisputed. Hence, determinations of the rate of evaporation, solely from water temperature observations without using meterological data, explicitly must imply that the external factors influence the water temperatures, and thus indirectly determine the computed value of the evaporation.

Preliminary computations have yielded values of the solar radiation, the absorption coefficient of radiation, and the rate of evaporation, all in good agreement with observation. Judging from the experience already gained, any thorough investigation of evaporation from water surfaces should involve observations of the water temperatures at different depths and times. Moreover, a sufficiently refined theoretical development along the line indicated in the present paper may contribute to the important question: What is the actual rate of evaporation of water from a lake or reservoir? (Excerpts from author's abstract.)

A detailed explanation of the above theory, together with typical numerical applications and tables for facilitating the computations, is being prepared for publication.

WIND DRIFT IN RELATION TO GIPSY MOTH CONTROL WORK

During May and June, 1923, an interesting series of observations with small balloons was carried on by the Conservation Commission of the State of New York, Alexander Macdonald, commissioner,[1] in connection with investigations on the spread of the gipsy moth. Previous investigations had shown that wind is a very important factor in the spread of this pest. "Recently hatched caterpillars, less than a quarter of an inch long, are carried by winds when the temperature is 60° F. or higher, and under certain conditions may drift long distances, 20 or possibly 25 miles." Studies were therefore made with a view to determining the probable spread in a given period, the ultimate aim being to secure data on which to base the selection of the most practicable region for a "control zone," in which the destruction of all infestations could be accomplished with least expense and at the same time most effectively. The experiments were conducted under the immediate direction of Dr. E. P. Felt, chief entomologist.

In 1922 the most seriously infested area was that of western Massachusetts, southwestern Vermont, and northwestern Connecticut. Studies of wind frequency were therefore made at selected stations in this region and these showed during the period May 10 to June 8, 1923, that easterly winds occurred at the surface 9 per cent of the time, westerly winds 50 per cent, northerly 47, and southerly 17. The danger of spread into New York State is thus seen to be rather small, so far as surface winds are concerned. Data from the Weather Bureau stations at Albany, Burlington, and Northfield bear out this assumption.

These studies were supplemented by the use of some 7,000 hydrogen-filled toy balloons. The balloons were inflated for a minimum buoyancy, only low altitude drift being desired. Each balloon carried an addressed tag requesting the finder to fill in certain data and then forward the tag by mail. Of the nearly 7,000 balloons released reports were received from 422, about 6 per cent, and 298 of these contained detailed information. A large proportion came down in southern New England, some reaching the eastern and southern coasts and a few crossing the Sound and landing in Long Island. Thus, the general drift was southeastward. About 25 per cent maintained a practically constant direction throughout the flight; a few reached moderate heights and reversed their direction—one actually fell within 15 feet of its starting point, after being in the air more than 6 hours. *Somewhat less than 2 per cent of the total drift was in a westward direction.*

So far as the primary purpose of this investigation is concerned, the conclusion is that the spread of insects westward by wind is likely to be small and that therefore an effective control zone can be established and maintained at comparatively small cost. Meteorologically, the results are of interest as confirming in a general way our ideas of wind frequency in the lower levels, except that the percentage of easterly winds as determined from more extensive data is considerably greater than here shown. The shortness of the period of observation makes inadvisable anything like an unreserved acceptance of the results as generally representative, and, of course, to this extent the conclusion as to the effectiveness of a control zone should be likewise modified.—W. R. G.

[1] Thirteenth Annual Report, Legislative Document (1924), No. 30, pp. 158-169.

NEW ARRANGEMENT OF METEOROLOGICAL WORK IN PORTUGAL

Under date of February 25, 1924, the Director of the Marine Meteorological Service of Portugal, writing from Lisbon, informs this office of a decree of the Portuguese Government which effects a new distribution of the